# **Explosive Devices**





### <u>Lesson Administrative Page</u>

**Module:** Explosive Devices

**Scope:** This module provides individuals with the knowledge needed to recognize potential hazards and explosive devices, to include basic device type and design, device construction methods, and the components of improvised explosive devices. Additionally, the effects of explosive devices and when to initiate evacuation are discussed. The module also examines safety during explosive incidents and demonstrates how one might become a target for the terrorist's secondary device.

### **Instruction Objective(s):**

**Terminal Learning Objective:** At the conclusion of this module, the student will identify the characteristics of explosives, and the effects of a detonated explosive device.

Enabling Learning Objective 1.1: Differentiate characteristics of explosives

Enabling Learning Objective 1.2: Recognize indicators of explosive manufacture

Enabling Learning Objective 1.3: Recognize potential explosive indicators

#### **Practical Exercise:** None

#### References:

- Center for Domestic Preparedness, Office for Domestic Preparedness. *Technical Emergency Response Training (TERT)*. Anniston, AL: CDP, 2004.
- New Mexico Tech, Energetic Materials Research and Testing Center. 2004.
- Surviving the Secondary Device: The Rules Have Changed. U.S. Department of Justice Bureau of Justice Assistance. Office of Justice Programs, 1997.
- U.S. Department of Transportation. 2000 Emergency Response Guidebook. Chicago: LabelMaster, 2000.
- Federal Bureau of Investigation Bomb Data Center. <a href="http://www.emergency.com/fbibd.htm">http://www.emergency.com/fbibd.htm</a>.



# Awareness Level WMD Response Training

**Duration:** 1.0 hours (When this course is taught as Train the Trainer, the duration is extended to 2.0 hours in order to provide time to discuss teaching points thoroughly.)

**Method of Instruction:** Facilitated seminar format in a classroom environment

**Instructor Ratio:** 1:50 Students

**Required Reading Assignment(s):** None

**Evaluation Strategy:** End of course discussion







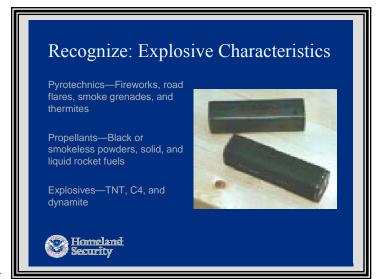
# Recognize: Explosive Devices as WMD

According to the FBI Bomb Data Center, approximately 70% of all terrorist incidents involve the use of explosives and incendiary agents. Because of the prevalence of use, individuals need to understand explosives in order to safely respond to an explosive incident.

### **Explosive Characteristics**

Energetic materials can be divided into three categories:

- Pyrotechnics are produced to create smoke, light, heat, and sound. There are numerous pyrotechnics: "work-horse" however these are not typically suicide bombing used in attacks, but are used in other types of bombings or arsons. Examples: fireworks, flares, smoke grenades, and thermites
- Propellants, also referred to as low explosives, are designed to provide a controlled release of



- gas to perform useful work. This gas can be used to push something (such as a bullet from a gun, or the space shuttle into space). While not typically used in suicide bombing attacks, they could be utilized due to their easy accessibility in the U.S. The vast majority of Improvised Explosive Devices (IED) in the U.S. has historically incorporated propellants. Examples: black or smokeless powders, solid, and liquid rocket fuels
- Explosives, also referred to as high explosives, are designed to yield a near-instantaneous release of energy. When we try to harness the energy released from explosives, it is normally for destructive purposes. A bomb designed to cause maximum dispersion of shrapnel is intended to kill and cause property destruction. Examples: TNT, C4, and dynamite are common examples of explosives



### Stimuli (Insults)

Stimuli or insults can occur in six forms: heat, friction, impact, electrostatic discharge, shock, and radio frequency. Each category of energetic material has different levels of sensitivity to stimuli or insults an individual can inadvertently induce into an incident scene resulting in an accidental detonation.

 Heat—Can be in the form of a fire or an atmospheric temperature change. Consider the effect on sensitive explosives or hazardous chemicals that have



crystallized. Moving it from an air-conditioned building to the sweltering heat on a hot summer day may initiate the material. Further, some chemical combinations are hypergolic (igniting upon contact of components without external aid) in nature. Additional heat may impart the stimuli necessary to start a rapid chemical decomposition of the material, whereby they begin to react violently with each other, and result in the material combusting or exploding

- Friction, Impact, Electrostatic Discharge (ESD), and Shock—These insults often cause accidental detonations if an individual inadvertently imparts them into the environment. Individuals may not realize they are in an explosive environment until visual explosive indicators are identified at the scene. That may be as close as the doorway to a room on a high-risk entry, or a routine fire inspection. In such cases, it is critical that no stimulus is introduced into the scene to generate an accidental detonation. Opening a lid on a jar, or attempting to remove an end cap could set off a container's content. One does not need to actually touch a device to deliver electrostatic discharge. Electrostatic discharge can also arc. Accidentally dropping an item can result in the explosive detonating
- Radio Frequency Energy (RFE)—Radio transmissions should be kept at a minimum to lessen the possibility of initiating the explosive device. RF energy has the possibility of interfering with remote control devices and causing them to function. Many first responder radios are also not intrinsically safe. Local or state bomb technicians should be contacted for their guidance in the absence of a department policy. Once explosive indicators are identified or suspected at a scene, individuals should, as rapidly as the situation allows, withdraw themselves and the public to a safe perimeter, make communications, and contact their bomb technicians for proper handling of the scene. Only qualified bomb techs should be assessing bona fide suspicious packages and vehicles



### **Categories of High Explosives**

There are three high explosive categories: primary, secondary, and tertiary. Each category designates a different level of sensitivity to stimuli, primary being the most sensitive—to tertiary being the least sensitive.

Primary
 Explosives—Extremely
 sensitive and, as a
 consequence, extremely
 dangerous. Very small
 quantities—a single, salt grain sized silver azide crystal, for
 example—can undergo



deflagration to detonation transfer (DDT). Simply breaking a crystal can cause detonation. Almost all detonators contain primary explosives

- Secondary Explosives—Generally far less sensitive than primaries. They are the explosive materials more commonly used in bulk. Most people are familiar with these materials, which include TNT, C4, and dynamite. Secondary explosives are made to withstand rough handling. Detonating a secondary explosive requires the tremendous energy levels created by another explosion, usually created by a primary explosive found in a blasting cap
- *Tertiary Explosives*—Based on ammonium nitrate (AN), which is a very insensitive substance. Tertiary explosives typically require the initiation from a secondary explosive to cause detonation. A blasting cap will not generally initiate them. Usually, a large mass (one-half-pound range) of secondary explosive (referred to as a booster) is needed for this purpose. For example, a stick of dynamite can be used to initiate a tertiary explosive

Often these explosives require confinement, especially in small quantities (pounds). However, in larger amounts (hundreds of pounds) they provide their own confinement.



### Case Study:

Although considered low-yield explosives, when properly manufactured and deployed, tertiary explosives can inflict mass casualties and catastrophic property damage.

In April 19,1995; Just after 9:00 am, a truck, containing a 4,000-pound Ammonium Nitrate/Fuel Oil (ANFO) bomb, pulled into a parking area outside the Alfred P. Murrah Building. The driver stepped down from the truck's cab and walked away. A few minutes later, at 9:02, the truck's deadly 4,000-pound cargo blasted the Alfred P. Murrah Building with enough force to shatter one third of the seven-story structure. The ANFO bomb is considered a tertiary, or low-yield, explosive.

### Case Study:

In March 11, 2004, a series of 10 bombs were detonated on Madrid's commuter train system. The ten bombs, consisting of Eco dynamite, were packed into sports bags with cell phones set to ring at different times to ignite the putty-like explosives. With 191 dead and 1,800 wounded, it was the worst attack in Spain's history. The Basque terrorist group, "Euskadi Ta Askatasuna" or "ETA" (translated "Basque Fatherland and Liberty") is said to be responsible for the bombings, however, there is much debate over who originated the attack. There have been suggested links to al-Qaeda, and it has been proven that ETA does indeed have past connections with al-Qaeda. The terrorists succeeded in shutting down commuter, regional, intercity, and international train traffic, and created chaos with the event.



# Recognize: Improvised Explosives

Most improvised explosives are comprised of chemical constituents easily found in any home or local community, even in large quantities.

Improvised explosives, such as military and commercial explosives, are typically mixtures of an oxidizer and a fuel. Regardless of type, all are extremely hazardous. Most improvised explosives are based on formulations used in commercial applications or research. Legitimate users do not use improvised explosives very often today. This is due to their sensitivity and unsuitability to be handled in a safe manner.





Improvised explosives can be as effective as manufactured explosives in many applications. Terrorists employ these in all sizes of devices. The following are common types of improvised explosives being utilized today by terrorists.

#### **Potassium Chlorate**

This explosive has approximately 83% of the power of TNT. Potassium chlorate is a common ingredient in some fireworks and can be purchased in bulk form fireworks/chemical supply

houses. Potassium chlorate normally appears in white crystal or powder form.



#### **Peroxide-Based IED**

Peroxide-based improvised explosives are an emerging threat domestically. However, these IED have been a common explosive used by international terrorists for some time. Hexamethylenetriperoxidediamine (hex-a-meth-i-len-trī-per-ox-īd-dī-a-men) (HMTD) and Triacetonetriperoxide (trī-ass-e-ton-trī-per-ox-īd) (TATP) were initially developed 100 years ago. They are both extremely sensitive and are used as an explosive by terrorists/bombers as both an initiator (blasting cap) and as a main charge. TATP is commonly found as the main charge being employed by Middle East terrorists in suicide bombings.

HMTD has between 60-116% of the power of TNT, and is comprised of peroxide (ideally 30% or above), citric acid, and hexamine (heat tabs). TATP has 88% of the power of TNT and is comprised of peroxide, acetone, and sulfuric (battery) acid.

**WARNING:** In dry form, HMTD and TATP could appear similar to crack cocaine. These explosives will react violently with drug field test kits. Individuals should consider, and look for, any indicators present on a drug scene that may also be indicators of explosive manufacture—this is becoming more common. If so, the investigator should consider marking the evidence as a possible explosive and sending it to their lab for testing. HMTD and TATP are ideal as explosives for improvised blasting caps, and were originally developed for such use.

#### **Powdered Ammonium Nitrate and Aluminum Powder**

Ammonium nitrate can be procured in powdered form—one example is a common cold pack. These use either ammonium nitrate in prill or powder. If ammonium nitrate is in prill form such as in fertilizer, it is a simple task to grind it into a powder. The aluminum powder can be procured at a professional paint store, or simply filed from an ingot. The explosive has 75% the power of TNT and is sensitive to friction impact, or ESD. It requires only a blasting cap for initiation.

While this is only one-half pound of explosive, consider that this mixture of readily available constituents has been used in very large devices. In 1997, there were three apartment complex bombings in Moscow and each consisted of ammonium nitrate in amounts equivalent to 500 pounds of TNT. The devastating effects from each of those devices resulted in over 100 casualties per incident.

### **Preparing Improvised Explosives**

- Commercial coffee grinders are very effective for the process of grinding
- Grist Mills for the crushing of barley or wheat are also effective. A ton of material can be processed through one this size in about two hours. Consider how terrorists might access such a machine
- Odd job mixers or even a concrete mixer would be suitable for the mixing of the ammonium nitrate and the liquid fuel



#### **Urea Nitrate**

Urea nitrate is also considered a type of fertilizer-based explosive, although, in this case, the two constituents are nitric acid (one of the ten most produced chemicals in the world) and urea. A common source of urea is the prill used for de-icing sidewalks. Urea can also be derived from concentrated urine. This is a common variation used in South America and the Middle East by terrorists. Often, sulfuric acid is added to assist with catalyzing the constituents. A bucket containing the urea is used surrounded by an ice bath. The ice serves in assisting with the chemical conversion when the nitric acid is added. The resulting explosive can be blasting cap sensitive. Urea nitrate has a destructive power similar to ammonium nitrate.

### **Hypergolic Devices**

Some improvised explosives are hypergolic in nature. This means when two particular chemical constituents are brought together they can violently react with each other, with the surrounding atmospheric temperature often being the catalyst; they are highly unstable and unpredictable. This reaction will result in either an incendiary effect or an explosion. An example is sulfuric acid (oxidizer) and sugar (fuel) in a Styrofoam cup. The acid slowly eats through the Styrofoam and mixes with the sugar, causing a hypergolic reaction within seconds and resulting in an explosion.

# Recognize: Improvised Explosive Device (IED) Components

IED generally consist of four components—power source, initiator, explosive, and switch. These components can be easily remembered by the acronym PIES(F). Each of the components is briefly discussed below.

Power sources—The majority
 of IED contain an electric
 initiator and, as such, require
 an electric power source.
 Batteries (a common power
 source) are manufactured in
 numerous shapes and sizes; in



some cases, they can be cut and shaped to make detection more difficult. Most commercially available batteries can reliably cause an initiator to function. Mechanical action, such as a spring under pressure, can store sufficient energy to cause the functioning of a non-electric initiator



- *Initiators*—Blasting caps or flame-producing components like fuse igniters for a length of time fuse. Improvised initiators causing low explosives or highly sensitive high explosives to detonate can easily be made. Examples of improvised initiators include a modified flash bulb, a percussion primer, or even improvised hobby fuses that impart flame much as time fuse, only at an uncontrolled burn rate. Initiators can also be improvised for high explosives. An example is an improvised blasting cap. Triacetone triperoxide (TATP) is a formulation used in improvised initiators
- Explosives—Have previously been discussed. However, as an IED component, explosives have a few additional characteristics that warrant discussion. When an explosive is incorporated into a device, it is not necessarily in contact with all other IED components. Often, these components will survive in some form after a device detonates. Recognize there is always evidentiary debris at a post-blast incident
- Switches—Incorporated into a device as either an arming switch or a fuse. They can be simple or complex in nature. More than one switch can be used to create redundancy in the system. Many IED will incorporate both an arming switch and a fusing switch. The arming switch is a safety for the IED and works by disarming (electrically disengaging) the fusing switch. When the arming switch is armed the fusing switch becomes functional; however, the circuit is still closed. When the fusing switch is activated, the circuit becomes open and will connect battery power to the initiator (blasting cap)—detonation will occur. Switches are almost unlimited in design and constructed so any approach or action by its intended target or a first responder will result in detonation. Switches specifically for IED can take on any form and can appear quite innocent looking—completely fitting into the environment
- Fragmentation and shrapnel—Part of the IED, wherein materials are added to the device for inflicting maximum casualties. Examples include ball bearings, nails, BBs, etc



# Recognize: Explosive Incident Response

There are three types of explosive incidents individuals may have to deal with and each has its unique response requirements; however, safety is of utmost importance in responding to each type. An individual who becomes injured or killed is no longer a part of the solution, but has become a part of the problem.

Pre-blast incidents—Will
most likely be reported to
dispatch and the first
responder will be sent to the
scene. Pre-blast perimeters
should be established based on

Recognize: Explosive Incident
Response

Pre-blast incident—Will most likely be reported to dispatch and the first responder will be sent to the scene

Post-blast response—Decisions will be based on the destruction caused by the blast, which is caused by the size of the explosion

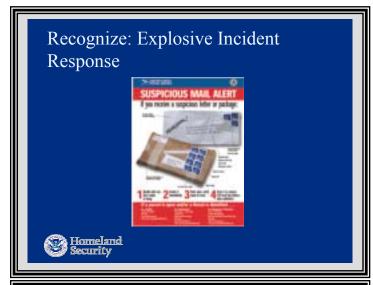
Continuing response incident—One of the most difficult types of explosive incidents

Secondary devices—Always anticipate a secondary device

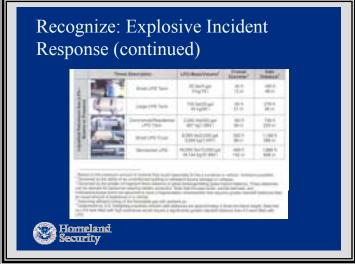
the Bureau of Alcohol, Tobacco, Firearms, and Explosives (BATFE) distance table. After establishing a safe perimeter, search and evacuation decisions must be made

- Post-blast response—Decisions will be based on the destruction caused by the blast, which is caused by the size of the explosion. The first, and perhaps the most important, decision will be where to establish the first (inner) perimeter or hot zone. After establishing the first perimeter, the next requirement is to begin victim triage and treatment. This may require collapsed building rescues; only individuals with the proper training and equipment should attempt such hazardous rescues. Fires may be present and utilities such as live electrical wires or punctured natural gas lines may cause additional hazards. In a post-blast incident response, it is important not to rush in, but to assess the incident before entering the area of the seat of the explosion
- Continuing Explosive Incident—One of the most difficult types of explosive incidents. It is an incident like that seen in Columbine, Colorado, where active shooters were present at a scene with explosive devices present











### **Secondary Devices**

Individuals should always anticipate a secondary device when responding to any of the three types of explosive incidents. Secondary devices are placed specifically to target individuals because terrorists seek to generate chaos and fear in the civilian population. Examples of secondary devices being placed to target individuals include the 1997 bombing of the Sandy Springs Family Planning Clinic, and the bombing of the Otherside Lounge, both in the Atlanta, Georgia area.

#### Case Study:

In 1997, Sandy Springs, GA Fire Department responded to what was reported to be a transformer explosion. When they arrived, they saw indications of a bomb blast and called police. Local, state, and federal agencies responded and were investigating the blast scene when a secondary device exploded. Only a few people suffered injuries. The chief of police reported that had the device not been placed low to the ground, and had several vehicles not been between the responders and the bomb, there would have been many casualties. This incident was the first secondary device in 20-plus years aimed to injure responders.

# **Avoid: Explosive Devices**

Individuals should use the principles of time, distance, and shielding to avoid explosive devices.

- Time—Minimize the time spent in the affected area. Less time spent in close proximity to a device means less exposure to the device. Once the potential for a device is recognized, quickly evacuate the area. Get out and stay out until the all clear signal is given
- Distance—Maximize the distance from the contaminated



*materials*. Exposure is inversely proportional to distance; therefore, greater distance means less exposure. Do not increase the distance to the point where the perimeter could not be controlled. If emergency service personnel are dealing with an explosive shipment, distances are delineated in the *ERG*. In all other cases, use the BATFE distances



• Shielding—Use shielding wherever it is necessary to reduce or eliminate exposure. By placing an appropriate shield between the potential explosive device and the individual, exposure may be reduced to an acceptable level

# **Isolate: Explosive Devices**

To prevent further harm from explosive devices, individuals should use standard isolation zone during an IED incident.

#### **Control Zones**

Control Zones—The designation of areas at the potential explosive device incident based on safety and the degree of hazard. If emergency service personnel are dealing with an explosive shipment, distances are delineated in the *ERG*. In all other cases, use the BATFE distances.

Isolate: Explosive Devices

Isolation Zone—This area extends 1,000 feet horizontally and vertically from a blast seat or a suspected IED

Protect Zone—This area extends 3,000 feet from the blast seat or a suspected IED and excludes all people not directly involved in the blast incident

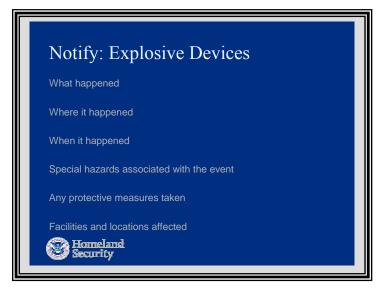
Flomeland Security

Never dismiss the possibility of secondary devices.

# Notify: Explosive Devices

One must follow local protocols for notifying emergency services and emergency support personnel.

- What happened
- Where it happened
- When it happened
- Special hazards associated with the event
- Any protective measures taken
- Facilities and locations affected





#### **Evacuations**

Responsible officials should make the decision to evacuate only after evaluating the threat. Automatic evacuations or total evacuations of a building or area may lead to additional threats and may affect future events; the next bomb may be set up outside in anticipation of the total evacuation. Responsible officials might consider an evacuation of the building or area if the situation dictates.

- No Evacuation—When responsible officials make a determination of no evacuation, all personnel in the area may continue with the normal routine
- Partial Evacuation—When responsible officials make a determination of a partial evacuation, only essential or needed personnel remain behind to continue operations

**Evacuations** 

No evacuation

Partial evacuation

Total evacuation

Bomb threats

Homeland

Who makes the decision?

• *Total Evacuation*—In a total evacuation, evacuate all personnel within the building or to a designated location

# Safety Considerations for Individuals

• Pre-blast post-blast conditions—Pre-blast conditions refer to the affected WMD environment and/or activities prior to a bomb detonating. This may include a host of activities such as building searches, evacuations, and render-safe procedures. Post-blast conditions refer to incident environment after a bomb has exploded. This will involve issues dealing with casualties, fire, and structural instability to name a few





- *Proximity of Exposures*—The distance of exposures from the explosive device will likely influence operational objectives such as evacuations, staging locations, medical treatment areas, and perimeter control points
- Commitment Level of on Scene Resources—Individuals should prepare for and anticipate difficult decisions early in the response pertaining to the level of operational engagement. For example, the incident commander may elect to commit individuals to rescue operations inside an unstable structure, or dedicate individuals to assisting evacuees in proximity to an improvised explosive device. Decisions that commit individuals to dangerous areas must include the use of a hazard and risk assessment and prescribed (agency) operational procedures
- Other Hazards—Individuals should always be aware of the potential for multiple hazards when on the scene of a WMD incident



#### Safety Standardization—

- Do not use two-way radios, radar or television transmitting devices within 300 feet
- Notify proper authorities, depending on the jurisdiction and situation
- Stage emergency medical service, fire, and police units outside the control point
- To prevent further harm from explosive devices, individuals should use standard isolation zones during an IED incident



# **Module Summary**



- Differentiate characteristics of explosives
- Recognize indicators of explosive manufacture
- Recognize potential explosive indicators

